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Marine Corps Shelterized Expeditionary Food Service System

MARINE CORPS ISO GALLEY
AND SANITIZING UNIT

BY ROBERT J. BUFFONE

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UNITED STATES ARMY NATICK
RESEARCH & DEVELOPMENT LABORATORIES
NATICK, MASSACHUSETTS 01760



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FOOD ENGINEERING LABORATORY

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Marine Corps requires a Food Service System that can be housed, for portability, within the 8 by 8 by 20 foot shelters of the Marine Corps Expeditionary Shelter System. This Food Service System is intended for use aboard container ships when such ships are used for troops transport. After the troops disembark, the Food Service Unit will be used for base-camp feeding. This report covers the development of the Marine Corps ISO Galley and Sanitation Unit from concept to technical feasibility/operational test. It also covers the description and capabilities of the Galley and Sanitation Unit and assures that the Knowledge gained in this		

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20. ABSTRACT (cont'd)

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PREFACE

During FY79-80, the US Army Natick Research and Development Laboratories conducted an investigation of Marine Corps Field Feeding under Task 04 Project No. 1G263747D610, Food Advanced Development. The individual Military Service Requirement (MSR) identification is USMC 0-2 Field Feeding. The purpose of this project was to define, develop, and evaluate the possibility of feeding marines on converted container ships as well as in the field from the same galley.

A design was formulated and a prototype fabricated that incorporated all of the characteristics specified. This project was subjected to conceptual and technical feasibility/operational tests.

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MARINE CORPS SHELTERIZED EXPEDITIONARY FOOD SERVICE SYSTEM MARINE CORPS ISO GALLEY AND SANITATION UNIT

INTRODUCTION

In 1977, NLABS was tasked by the Marine Corps to develop an improved Field Feeding System for the 1980's. The Feeding System (Galley) was to be compatible with the MC Expeditionary Shelter System (MCESS),¹ capable of feeding at battalion level. The galley was to be capable of preparing and serving A rations and was to be used onboard ship as well as in the field.

Several concepts were presented to the Marine Corps, and the particular one decided upon will be discussed in this report.

The Marine Corps decided on an all-electric galley that could prepare and serve A rations to 1,000 men. The galley would also have to be capable of being divided into two smaller galleys. One would be an intermediate size galley for 500 men and the other a smaller galley for 200 men. A prototype was developed and assembled at NLABS, using a combination of rigid and knockdown shelters and subjected to a 12-day Conceptual Test at Camp Upshur, Quantico, VA in July of 1980.²

As a result of this test, some modifications were made at Natick, along with the introduction of a newly developed sanitizing unit.

The prototype, including both the galley and sanitizing unit, was subjected to a 15-day Technical Feasibility/Operational Test at the Camp Wilson area of Twenty-Nine Palms, CA, in September of 1981.³

REQUIREMENTS

The performance characteristics to be embodied in the NLABS concept for a new/improved Field Feeding System for the Marine Corps for the 1980's are as follows.

- The system will provide up to three hot meals daily that meet the consumer acceptability of those produced by the current Marine Corps Field Feeding System with modifications allowed by utilizing the XM75 (self-contained) kitchen when using A rations.

¹N.D. Roberts, A.L. Murphy, Jr., R.J. Buffone. Marine Corps Shelterized Expeditionary Food Service System. NATICK/TR-80/033, August 1980.

²D.P. Leitch. Analysis of Data Collected at Camp Upshur. Disposition Form, ORSA, NLABS, 17 October 1980.

³C.F. Wright, Aberdeen Proving Ground, MD. Technical Feasibility/Operational Test. Report Number APG-MT-5620, January 1982.

- The system should be capable of operating both afloat and ashore.
- The system should maintain skill levels while reducing labor requirements by utilizing foods that shorten on-site pre-preparation effort and are compatible with the Field Hospital Feeding System.
- The system should assure availability of the foods in sufficient quantity under mobilization by using food processing and packaging techniques that have a high probability of continuing to be available or will become commercially available before 1985. High-risk concepts or components are not to be included.
- The system is to be compatible with hard shelters that meet International Organization for Standardization (ISO) standards and is to be capable of being transported by helicopter, truck, or trailer.
- The design is to accommodate troop units ranging in size from company to battalion and squadron to group by modularizing and making the food facility capacity capable of being scaled up or down, as required.
- The system should include a facility for sanitation operations (warewashing) that will be independent of the food preparation and serving unit.
- The time from start to ready-to-serve (including setup time) should not exceed six hours.
- The system must utilize fuels expected to be available in the 1980's or electricity. The upper limit or electrical availability is estimated at 100 kW.
- The system must be capable of heating and cooling meal components, as well as water only, while at the set-up location site.
- The system must accept pressurized cold water and must be capable of pumping its own water from water trailers or tankers. A specific method for heating water to 180°F should also be provided.
- Provisions must be made for trapping liquid wastes, removing fats and solids, and pumping waste to a leaching field, as well as disposition of all solid wastes.
- Refrigeration, both chill and freeze, will be required, and generators will be standard items of equipment available for the system.
- The design will minimize the effects of fumes, dust, insects, and inclement weather on operating personnel as well as on meal components.
- The system will not be designed for high usage rate of disposable mess gear nor disposable food preparation equipment.

DESCRIPTION

A. ISO Galley

The Marine Corps ISO Galley is an all-electric galley consisting of three laterally complexed 8' x 8' x 20' ISO shelters with intermediate walls removed and is designed to operate onboard container ships and in the field. The system is powered by three 60-kW generators, one per shelter, and includes hot and cold running water and a grease trap with discharge pump.

The basic galley is designed to prepare, cook, and serve A rations to approximately 1,000 men (Figure 1). The galley can be divided into two independent smaller galleys: an intermediate-size galley for 500 men (Figure 2) and a smaller galley for 200 men (Figure 3).

The galley utilizes three laterally complexed shelters, with two identical serving lines located along the outer walls, plus two access shelters that act as a weather protective cover for the serving lines and an area for dispensing utensils and condiments. Layout is seen in Figure 1. The walls of the ISO shelters are removable so that the serving lines will be accessible to the customers from the access shelters (see Figures 4 through 8). A 48" x 24" griddle, a three-well, steam-jacketed kettle, and a convection oven for baking and roasting are the major cooking components stationed on the serving line. For a detailed list of equipment for the ISO galley, see Table 1. The steam-jacketed kettle gives the galley the necessary capability for quick-cooking items such as vegetables, potatoes, spaghetti, and various foods that will be used in considerable quantity and are cooked by boiling, stewing, or heating in water. This particular kettle is configured to accommodate the standard steamtable pan and will be used in lieu of conventional single-purpose steamtables. This versatile item, therefore, acts in a dual capacity, offering a means for both cooking and serving. In addition, these kettles can be directly employed as water heaters for the preparation of Tray Pack foods.

The convection oven has racks spaced for 2-1/2 in. deep steamtable pans; it will accommodate 10 full-size pans or 20 half-size pans. Three separate ovens are supplied: two of them to be transferred to the serving/preparation shelter when that unit is detached to function at the 500-man level and one for the 200-man level.

On each line, there is also a combination steamtable/warming cabinet and a serving table that affords serving and work space and supports secondary components such as the toaster, coffee, brewer, and beverage dispensers. A brief description of these components follows.

a. For 1,000 customers, a toaster capable of continuous production is necessary. Accordingly, a conveyor toaster, rated at 16 slices per minute, was chosen so that each line is capable of serving 960 slices of toast per hour.

b. The coffee brewer is an automatic 5-warmer unit. One unit has a "High-Medium-Low" switch and is capable of boiling water. Each of the five stainless steel coffee decanters included has a capacity of 32 ounces.

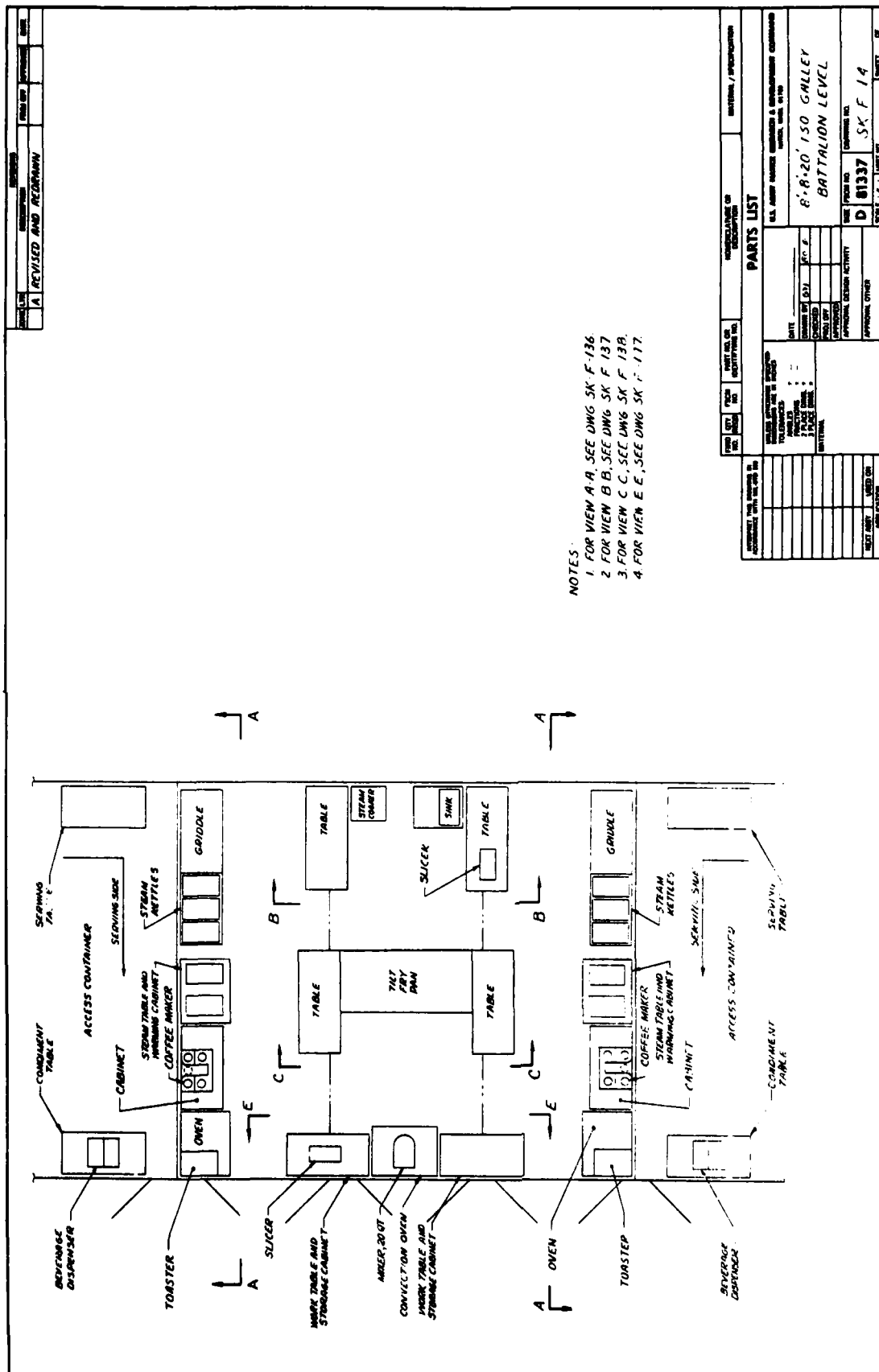


Figure 1. 8' x 8' x 20' ISO Galley Battalion Level

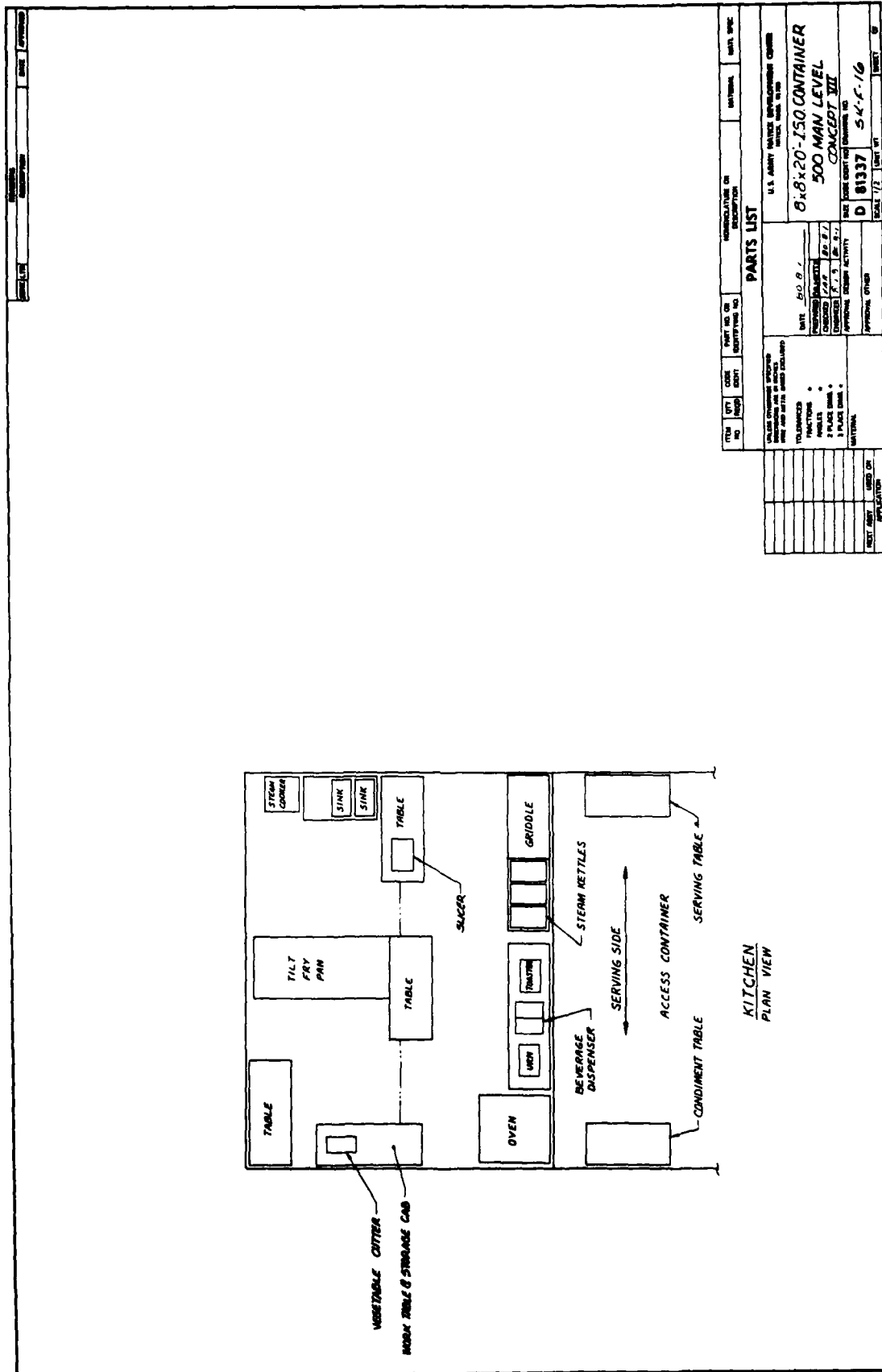
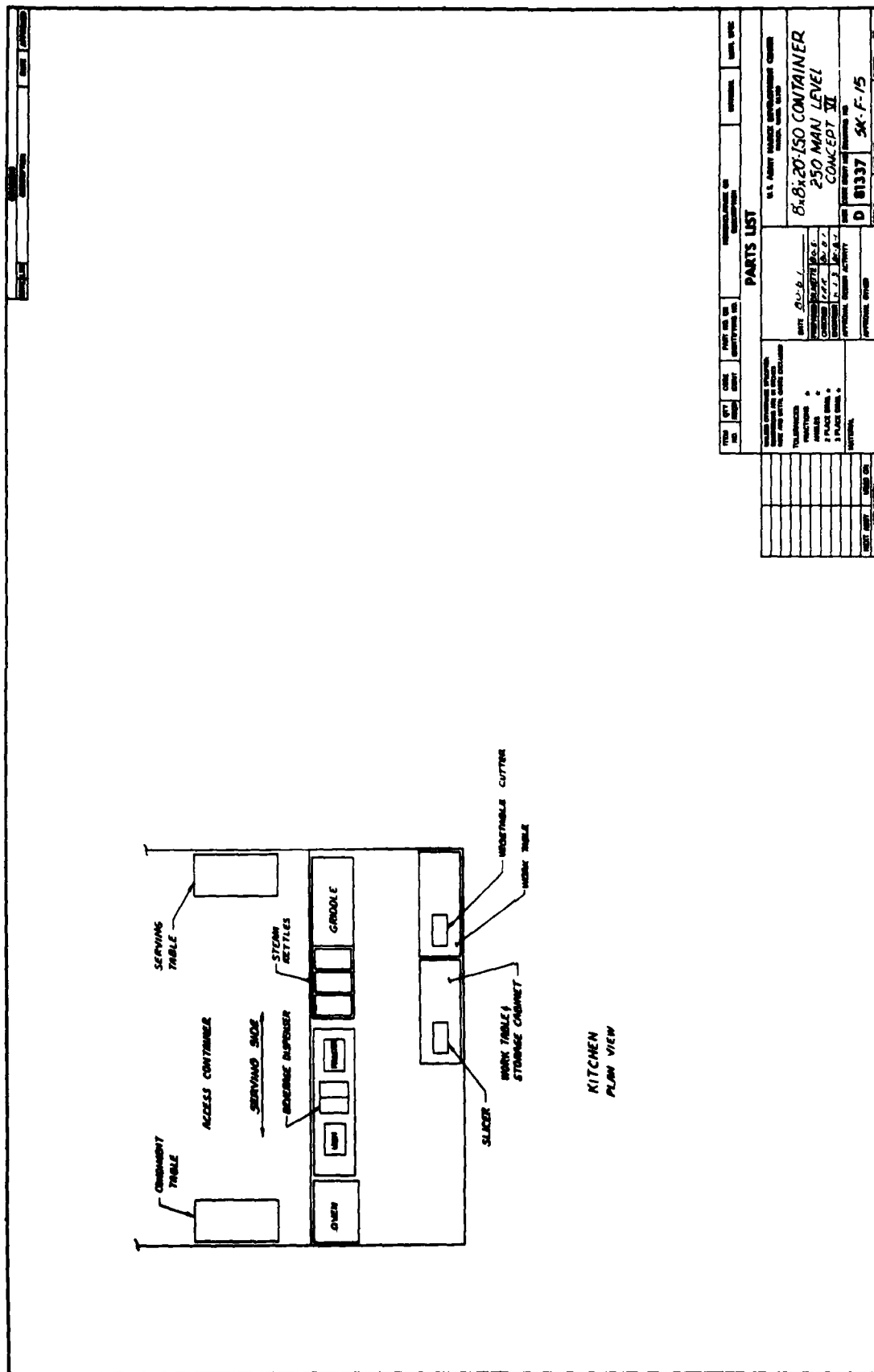


Figure 2. 8' x 8' x 20' ISO Container 500-Man Level



TYPE	QTY	CODE	QTY	PRICE	DATE	REMARKS	DATE	QTY	PRICE	DATE	REMARKS
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Figure 3. 8' x 8' x 20' ISO Container 200-Man Level

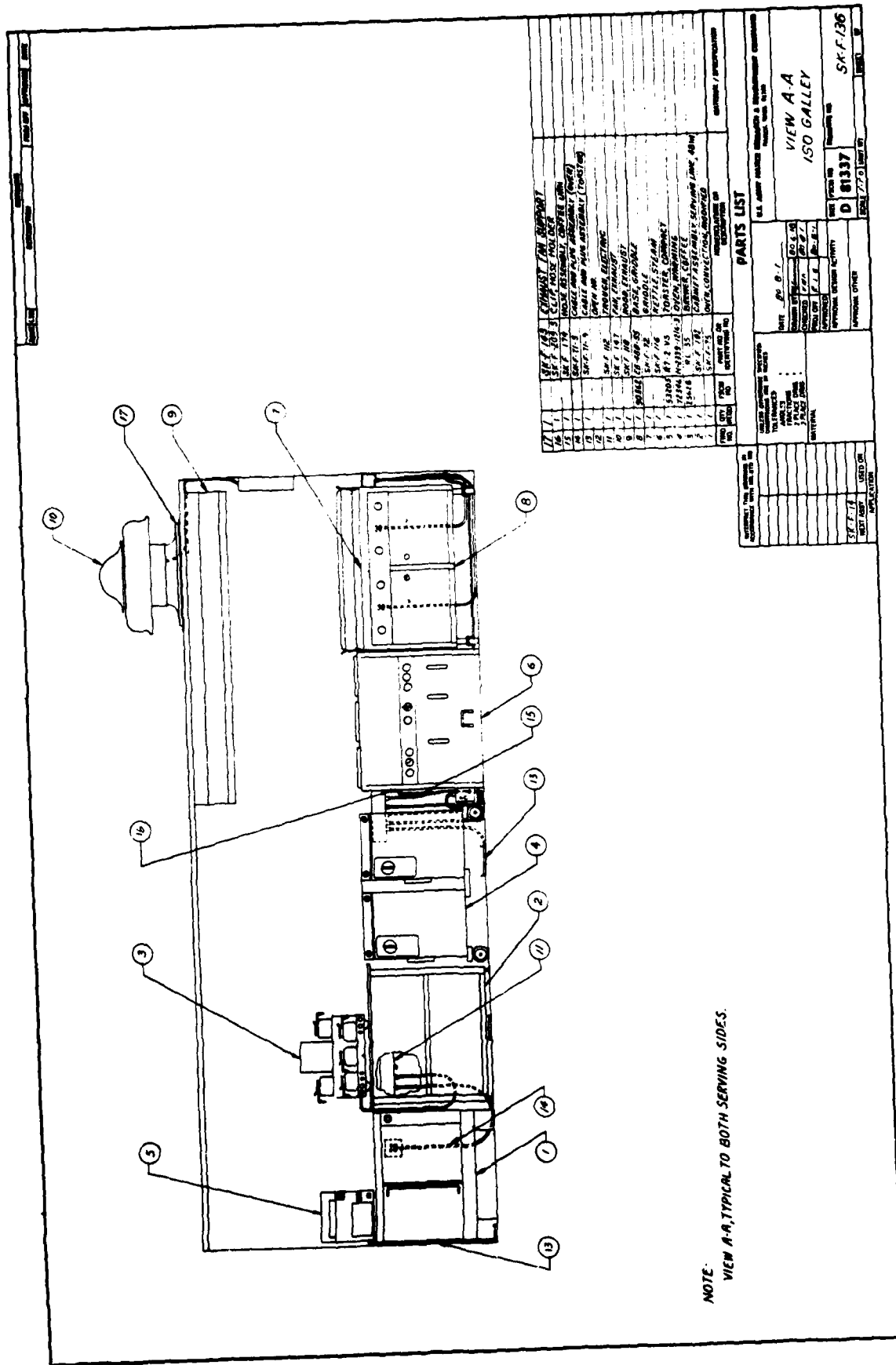


Figure 4. View A-A ISO Galley

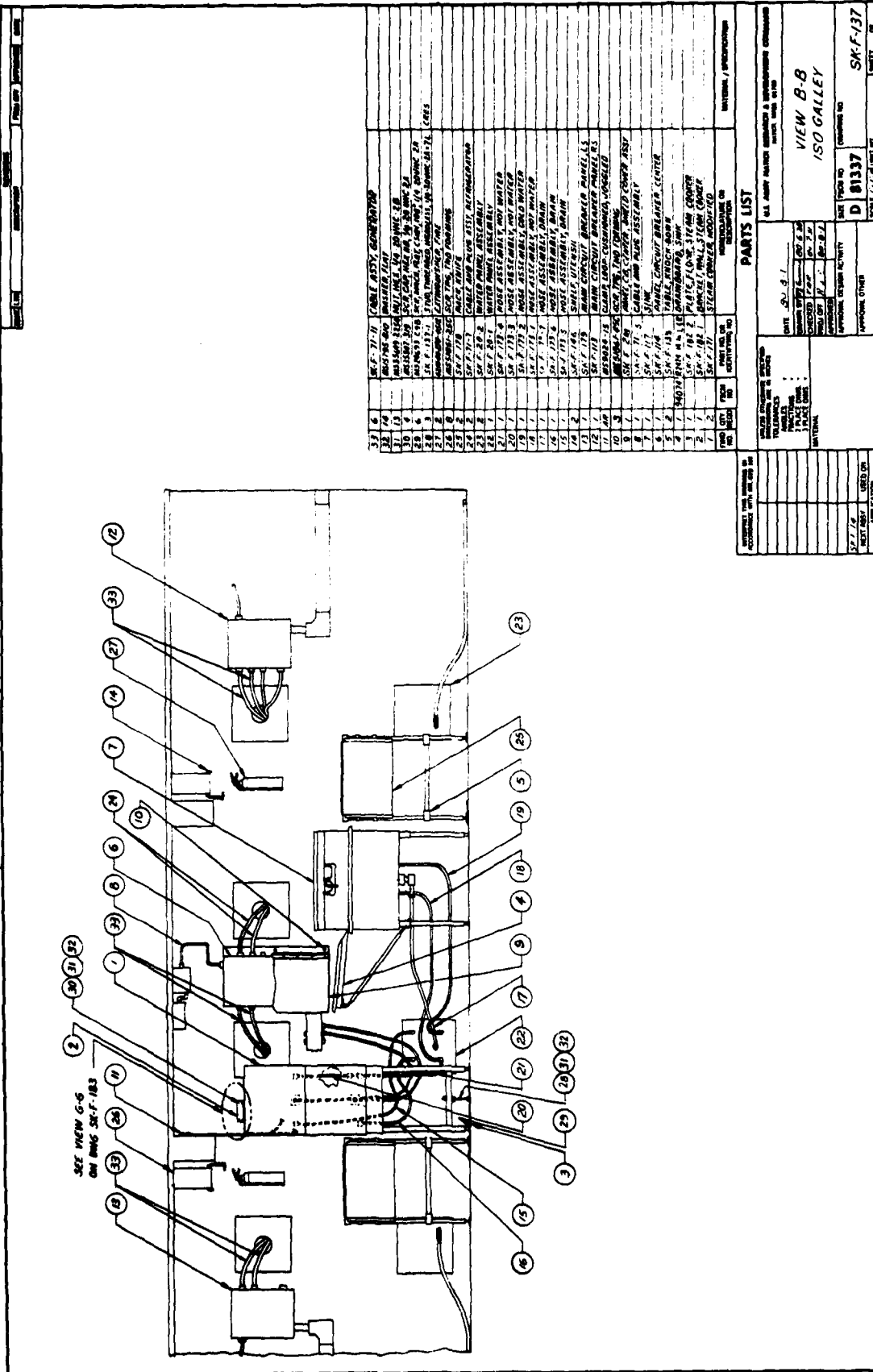
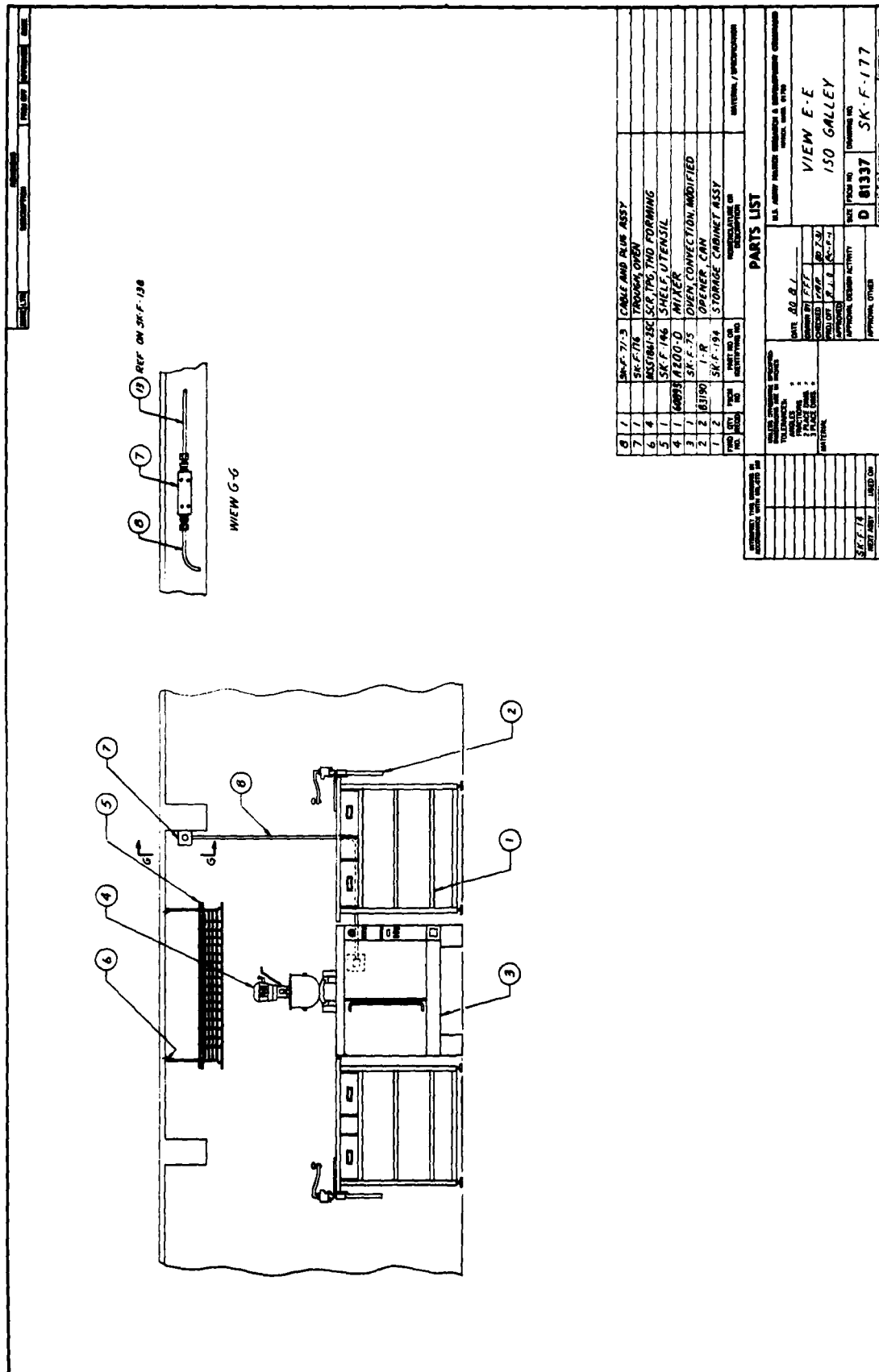


Figure 5. View B-B ISO Galley



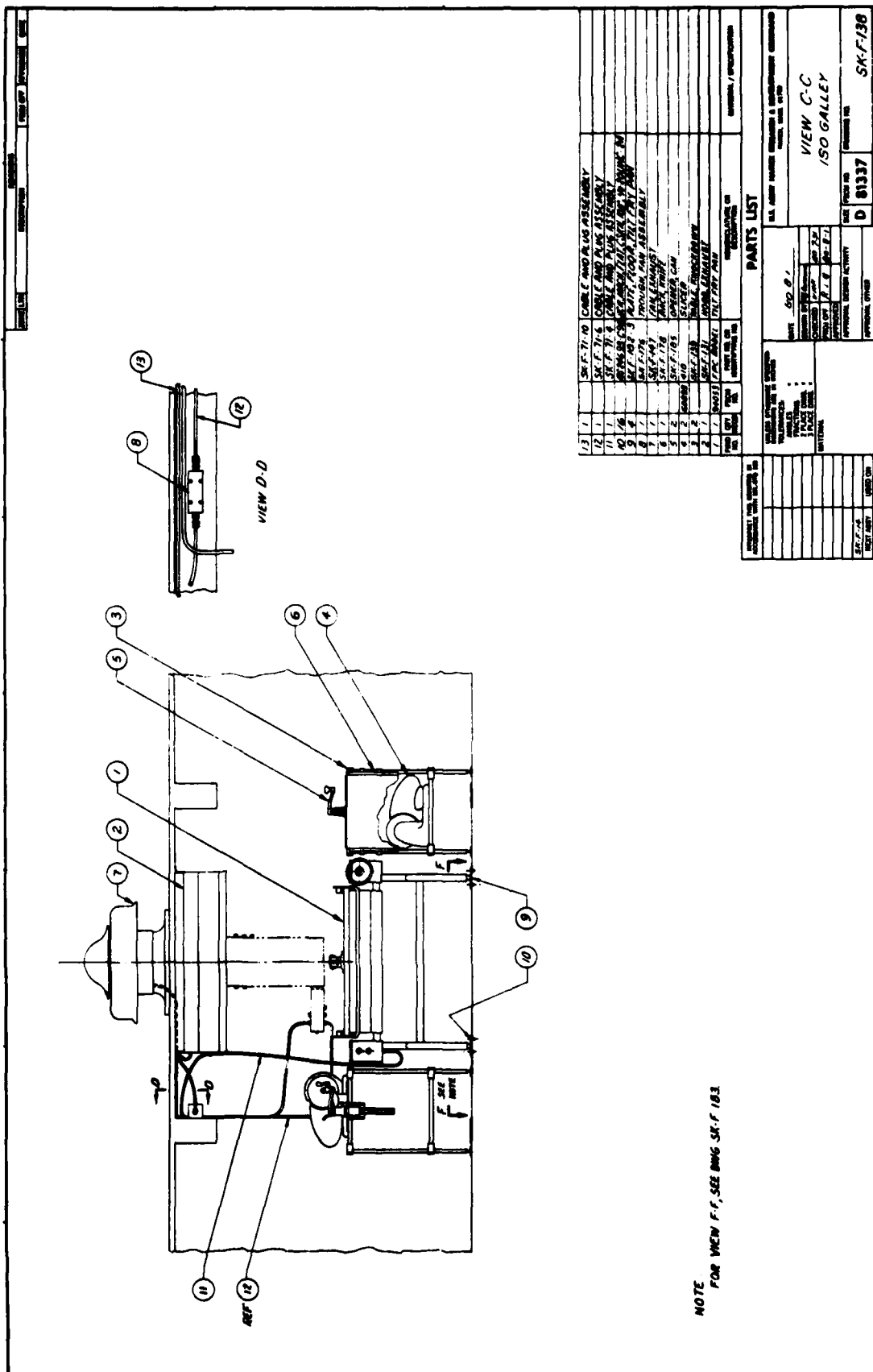


Figure 7. View C-C ISO Galley

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Figure 8. ISO Galley Complex

Table 1. Table of Equipment: ISO Galley

Item	Description	Quantity
8' x 8' x 20' Cont. Rigid	ISO	3
8' x 8' x 20' Cont. Knockdown	ISO	4
8' x 8' x 10' Cont.	Refrigerators	2
Cable	Jumper, 12' long	2
Cables	For Refrigerator	2
Cables	For Dry Storage Area	2
Generator, 60 kW	NSN 6115-00-118-1243	3
Cables	Generator, 5-Wire - #4	6
Grease Trap		1
Hose Assembly	Grease Trap, Discharge	200'
Water Heater Assembly	MIL-H-44086	1
Water Pump		1
Hose	Pump to Manifold (Blk)	1
Cold Water Manifold		1
Fuel Lines	Heater	2
Fuel Lines	Generator	3
Water Inlet Panel		3
Hose Suction	25' (Red)	2
Hose, Steam Condensate	Green	2
Hose, Hot Water Inlet	Red	1
Hose, Drain	From Galley (Grn)	1
Hose Assembly	Pump to Heater (Blk)	1
Hose	Pump to Pump	1

Table 1. (cont'd)

Item	Description	Quantity
Plug Adaptors	Generator Cables	3
Hose, Hot Water Outlet	25' (Red)	1
Jack	10 Ton	1
Cable Assembly	Heater	1
Roof Ventilating Fans w/cables		3
Cable Assembly, Grease Trap		1
Main Lug Panel	Bryant 3-36-42 BSM	3
Griddle, w/2 cables	Star Mfg. Co., 158-48"	2
Splash Guard		2
3-Well Steam-Jacketed Kettle w/4 cables	Groen, Dover Corp.	2
Toaster, Horizontal Conveyor w/cable	Savory Equipment Co.	2
Beverage Container	5 Gal., Cambro	12
Coffee Brewer	Bunn-O-Matic Corp.	2
Coffee Dispenser	Bunn-O-Matic Corp.	1
Oven, Convection	Blodgett Co., Inc.	3
Steam Cooker w/stand and cables	Wearever	2
Tilt Fry Pan	Groen, Dover Corp.	1
Food Slicer	Hobart Corp.	2
Sink and Drainboard	1-Well	1
Cabinet	48" Long	2
Cabinet w/drawers	42" Long	2
Steamtable/warm cabinet	Crescor, H-2339-1216-3	2

Table 1. (cont'd)

Item	Description	Quantity
Mixer, 20 Quart	Hobart A-200-D	1
Table, Knockdown	60" long, stainless	4
Table, Knockdown	48" long, stainless	2
Table, Knockdown	42" long, stainless	2
Hose Assembly	Coffee Urn	2
Hose Assembly, Cold Water	Sink	1
5 Gal. Water, ST, Jack, Kit		1
Complexing Kit		4
Hose Assembly, Hot Water	Sink & Steam Cooker	3
Hose Assembly, Drain	Sink	1
Hose Assembly, Drain	Steam Cooker	2
Exhaust Hood	Griddle	2
Exhaust Hood	Tilt Fry Pan	1
Cable Assembly	Fan, Extension	1
Cable Assembly	Coffee Urn	2
Cable Assembly	Conv. Oven	3
Cable Assembly	Tilt Fry Pan	1
Cable Assembly	Toaster, Extension	2
Cable Assembly	Jumper for Lights	3
Floor Mats	Grey Vinyl - 19' long	4
Floor Mats	Grey Vinyl - 7' long	3
Ships Clock		1
Rack Utensil		3

Table 1. (cont'd)

Item	Description	Quantity
Tray Pack Lifters		4
Can Opener	Edlund Model 1-R	4
Pan, Baking & Roasting	NSN 7330-00-634-4494	8
Board, Food Slicing & Chopping	NSN 7330-00-078-5706	3
Pad, Bakery	NSN 7330-00-379-4439	4
Pot, Cooking, 10 Gal	NSN 7330-00-292-2306	4
Cover, Pot, 10 Gal	NSN 7330-00-250-6300	5
Pot, Cooking, 15 Gal w/cover	NSN 7330-00-292-2307	2
Tongs, Food Service SS 12 in.	NSN 7330-00-616-0997	10
Spoon, Serving, Slotted 15"	NSN 7340-00-205-1421	10
Colander, SS 16-Qt.	NSN 7330-00-266-7453	2
Knife, Boning	NSN 7340-00-197-1271	6
Knife, Cooks	NSN 7340-00-488-7950	5
Knife, Paring	NSN 7340-00-488-7939	6
Knife, Steak	NSN 7340-00-197-1274	6
Turner, Food	NSN 7330-00-256-2158	4
Skimmer	NSN 7330-00-237-8277	5
Dipper No. 56	NSN 7330-00-237-8277	1
Ladle	NSN 7330-00-248-1153	7
Ladle, Gravy	NSN 7330-00-254-4793	2
Measuring Set, Spoon	NSN 7330-00-272-7876	3
Peeler, Potato	NSN 7330-00-238-8316	7
Spoon, Food Service	NSN 7340-00-223-7800	5

Table 1. (cont'd)

Item	Description	Quantity
Spoon, 15"	NSN 7340-00-240-7080	8
Fork, 15"	NSN 7340-00-223-7791	6
Fork, 21"	NSN 7340-00-223-7792	7
Dispenser, Pancake	NSN 7330-00-412-2449	2
Bowl, Food Mixing, 21 Qt.	NSN 7330-00-262-2323	4
Strainer, China Cap	NSN 7330-00-815-1456	3
Scraper	NSN 7330-00-205-1950	3
Egg Whip	NSN 7330-00-815-1458	5
Steamtable Pan, Full Size, 2-1/2" Dp.		12
Steamtable Pan, Full Size, 4" Dp.		13
Steamtable Pan, Full Size, 6" Dp.		14
Steamtable Pan, Half Size, 2-1/2" Dp.		8
Steamtable Pan, Half Size, 4" Dp.		11
Steamtable Pan, Half Size, 6" Dp. 4 Rec.		4
Flat Cover, Full Size		11
Flat Cover, Half Size		8
Utility Turner		3
Fire Extinguisher, Dry Chemical, Class A, B & C Fires		2
Pan, Baking, Sheet	NSN 7330-00-633-8905	22
Bowl, Food Mixing, 7 Qt.	NSN 7330-00-241-8168	6
Paddle, Food Stirring		2
Knife, Meat Slicing	NSN 7340-00-680-0863	6

Table 1. (cont'd)

Item	Description	Quantity
Can, Trash	NSN 7240-00-819-7735	5
Cylinder, Flatware, Washing & Dispensing	NSN 7320-00-708-9568	12
Dispenser, Condiment, Countertop	NSN 7320-00-910-6262	2
Rack, Cutlery	NSN 7320-00-856-6891	3
Tool Box	Misc.	1
Awnings		2
Door Screens		7
Box, Spare Parts		2
Wet/Dry Vacuum Cleaner		2
Air Curtain		6

c. It is desirable that the serving line contain a type of insulated container/dispenser for holding and dispensing liquids, such as fruit juices, punch, etc. A typical breakfast requires approximately 40 gallons of juice. Two 5-gallon beverage dispensers that will require refilling once during the meal have been selected for each serving line.

d. A meat slicer, three cutlery racks, four can openers, with two more work tables are also part of each serving/preparation container's complement of equipment when functioning at battalion level.

e. The center container, or food preparation module, contains a sink, a tilt fry pan, two storage cabinets, and a steam cooker. The tilt fry pan offers a cooking surface of approximately 960 square inches (24" wide x 40" long) and by virtue of its versatility, enhances production as well as general food preparation capabilities. The tilt fry pan can be used in the preparation of gravies, sauces, scrambled eggs, fried potatoes, and other foods that can be prepared by similar techniques.

f. For a fast method of cooking vegetables, meats, seafood, eggs, and noodles, a steam cooker is furnished to supplement other food preparation equipment. The steam cooker, with self-contained steam generator, will accommodate four half-size steam table pans.

For various views of the galley and food preparation equipment, see Figures 9 through 16.

B. Sanitizing Unit

The Marine Corps ISO Sanitizing Unit is all-electric, consists of two laterally complexed standard 8' x 8' x 20' ISO shelters, and is designed to operate alongside the ISO Galley. The system is powered by a 60 kW generator (see Figures 17 through 21).

The unit consists of a soiled ware removal or feed table attached to an automatic conveyor, low temperature tray washer. On the exit side of the tray washer is an L-shaped discharge table capable of holding five racks. The table is equipped with a table limit switch, which automatically turns the machine off in the event of a pileup of racks.

On the opposite wall are two work tables, one on each side of a three-well sink. The sink is equipped with a drainboard and the third well has a sink sanitizer that boosts water temperature and maintains it at 180°F.

The unit also consists of three tray-storage racks, a wire rack, and two scrap tables with garbage cans.

For a detailed list of equipment for the sanitation unit, see Table 2.

Hot water, in field operations is supplied by a modified military shower bath water heater.



Figure 9. Sink Wall

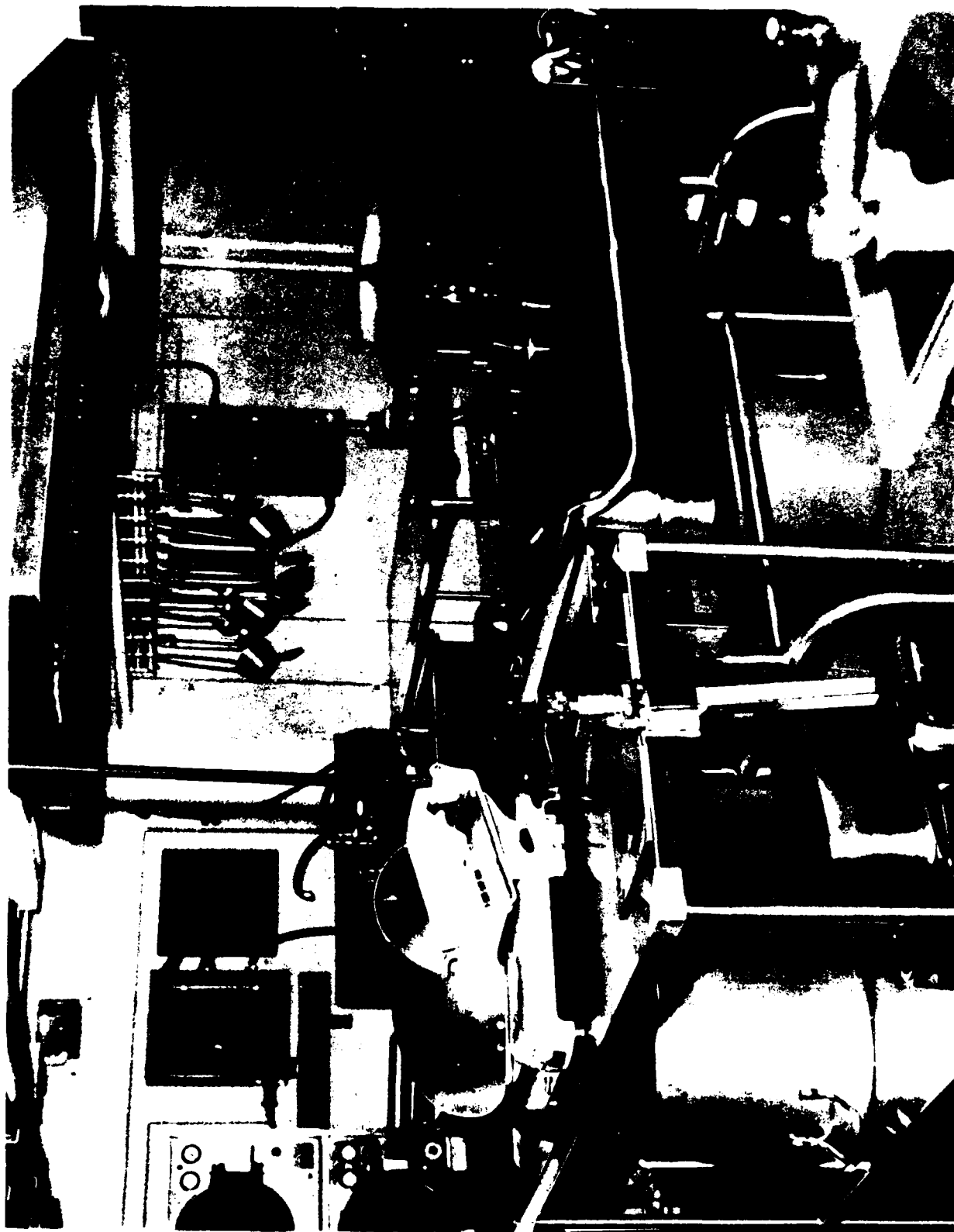


Figure 10. Center Module Food Preparation Area

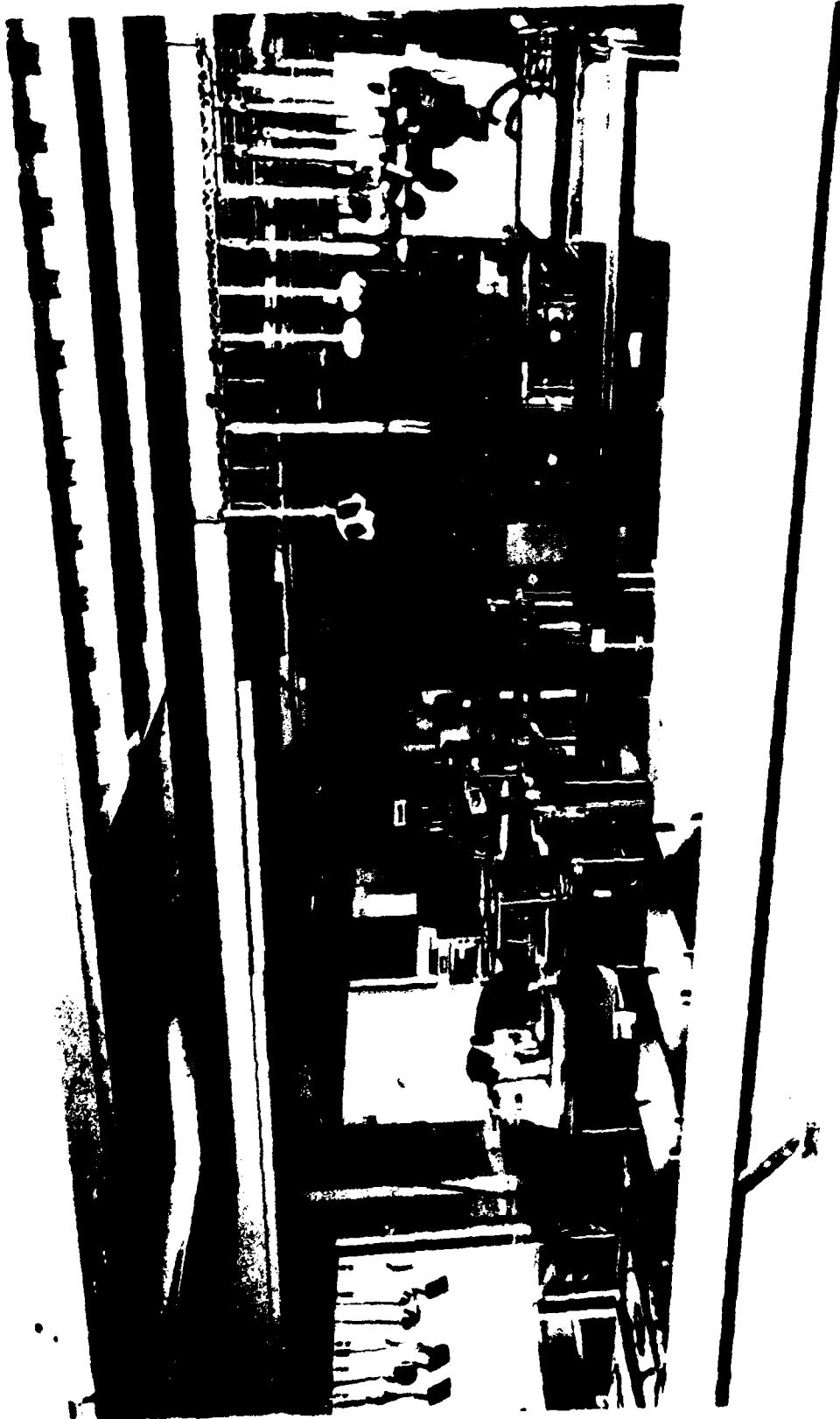


Figure 11. Serving Line Near Side

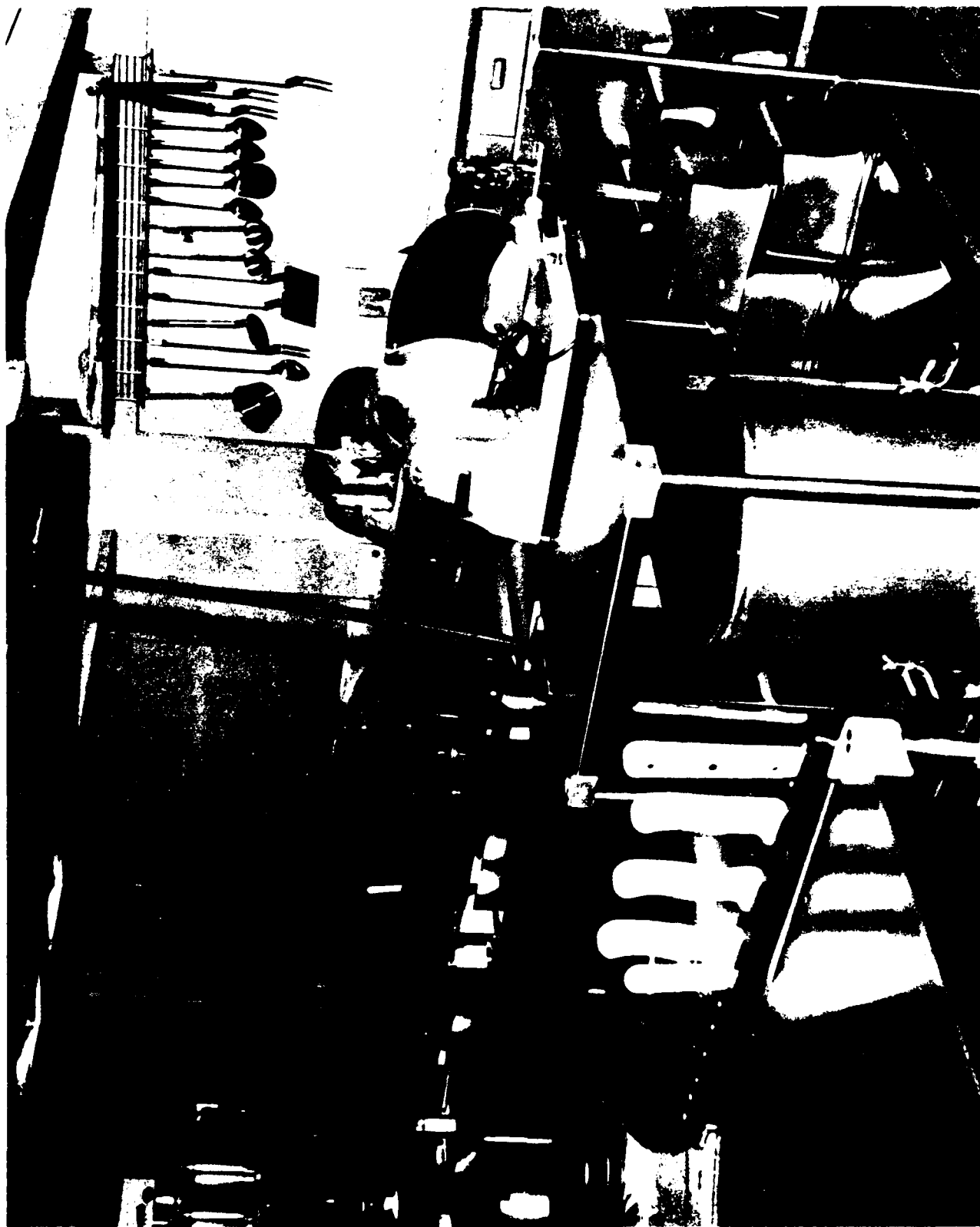


Figure 12. Rear Wall



Figure 13. Serving Line Far Side



Figure 14. Food Preparation Area

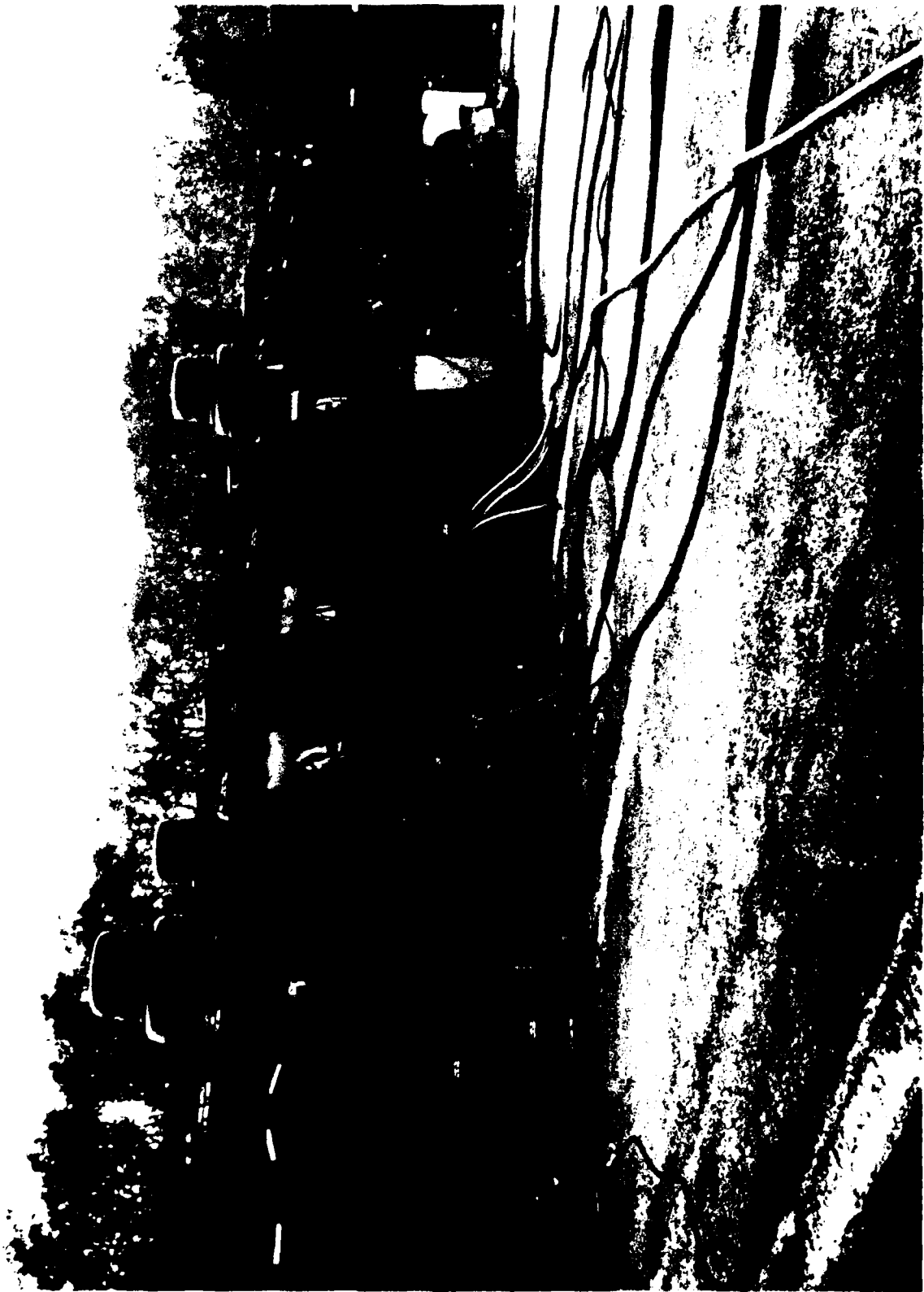


Figure 15. Outside Rear View of Galley



Figure 16. Generators and Water Heater

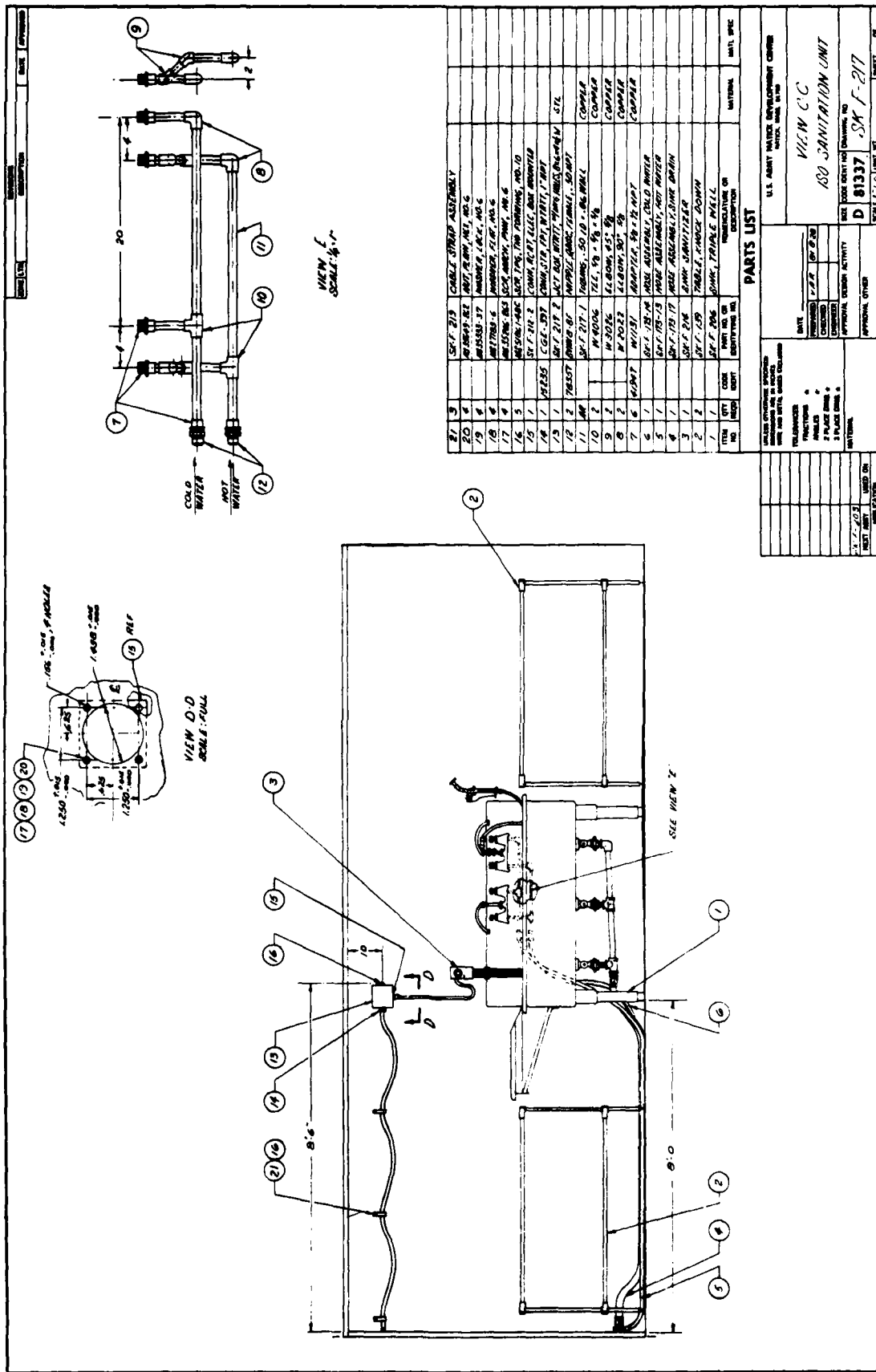


Figure 19. View C-C ISO Sanitation Unit

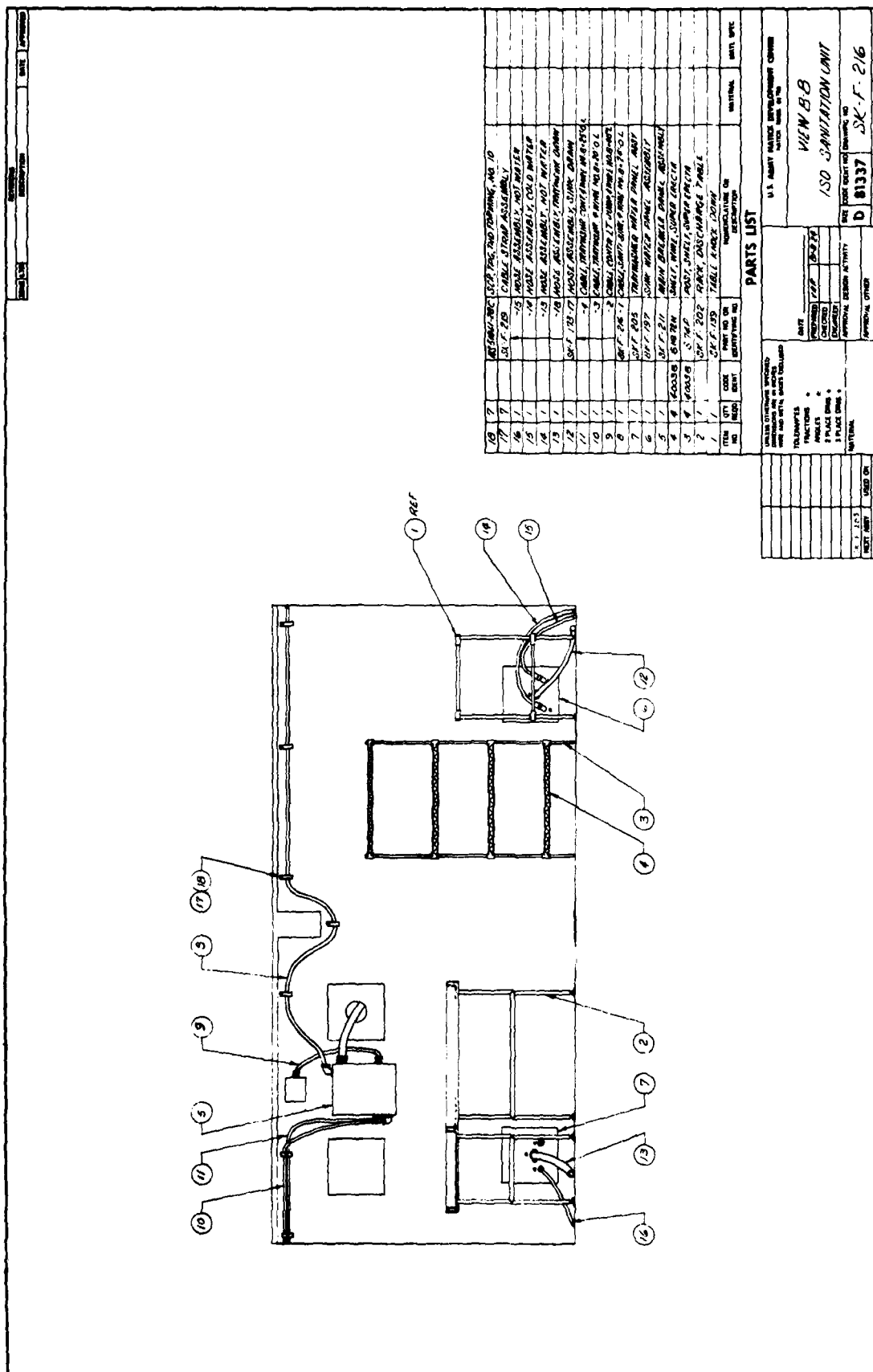


Table 2. Table of Equipment: ISO Sanitation Unit

Item	Description	Quantity
8' x 8' x 20' Container	ISO Rigid	1
8' x 8' x 20' Container	ISO Knockdown	1
Cable, Jumper	12' Long	1
Generator, 60 kW	NSN 6115-00-118-1243	1
Cables, Generator	5-Wire, #4	1
Water Heater Assembly	MIL-H-44086	1
Ships Clock		1
Water Manifold		2
Fuel Lines		2
Water Inlet Panel		2
Hose, Suction	25' (red)	2
Hose, Hot Water Inlet	25' (red)	4
Hose, Cold Water Inlet	25' (black)	1
Hose, Drain	From unit panel to sump 1-1/4" (grn)	1
Hose, Drain	Washer panel to sump 2" (grn)	1
Hose, Drain	Sink to panel 1-1/4" (grn)	1
Hose, Drain	Washer to panel 2" (grn)	1
Complexing Kit		1
Plug Adapter	Generator Cables	1
Cable Assembly	Heater (spare)	1
Main Lug Panel	Bryant 3-18-36-BSM	1
Sink, Spray Head & Drain Board	3-well	1

Table 2. (cont'd)

Item	Description	Quantity
Tray Washer	Hobart C-ES-66	1
Work Table	60", stainless	2
Discharge Table	63", stainless	1
Feed Table	60", stainless	1
Scrap Table	60", Knockdown	2
Rack	Tray Storage	3
Rack	Wire	1
Hose Assembly, cold water	Sink 1/2"	1
Hose Assembly, hot water	Sink 1/2"	1
Hose Assembly	Washer, 3/4"	1
Sink Sanitizer	Toastmaster SS-2	1
Cable Assembly	Washer	1
Cable Assembly	Washer Contr.	1
Cable Assembly	Sink, Sanitizer	1
Floor Mats	Grey Vinyl (19' long)	2
Glass Tumblers		1,000
Knives		1,000
Forks		1,000
Spoons		1,000
Screens		2
Awning		2

GALLEY PERFORMANCE

The ISO Galley was tested, first, for basic concept feasibility at Camp Upshur, VA and, second, for operational performance and an assessment of transportability and maintainability, following changes as dictated by the concept evaluations and incorporation of the sanitizing unit.

A. Camp Upshur Test Results

This section will cover, briefly, the results of the evaluation test conducted at Camp Upshur in July of 1980.² The object of the test was to determine the feasibility of the proposed concept¹ in regard to preparing and serving A, B, and T-Rations at battalion level and also at the intermediate and smaller size levels.

Data collected at the Camp Upshur Test covered the following areas.

1. **Meal-Serving Rate.** The average service rate per line throughout the test was between seven and eight men per minute. At this rate, the ISO Galley was able to serve the noon and evening meal to a battalion-size population, about 1,000 men, within a reasonable time period of 1.125 hours, provided the food was ready to serve before opening the two serving lines and adequate storage for this food was available.

2. **Power Consumption.** The most heavily equipped section of the main galley drew a maximum power of 51 kW, according to recording watt meters installed in the power line. Since this test was to determine if 60-kW generators could furnish sufficient power for each of the galley sections, it appears that such generators would be adequate.

3. **Equipment Utilization.** Of the nine items of equipment sampled, only five demonstrated a productivity rate (the percentage of time that an item is "On" or "On and in Use") of over 10%. These items were the two steam kettles, the two ovens, and the tilt fry pan. The items that demonstrated productivity rates of less than 10% were the two griddles and the two steam cookers. The low rates of productivity experienced by the griddles can be attributed to the fact that griddle-type items, such as eggs and short-order foods, were simply not offered during the test and the fact that all of the foods prepared in the ISO Galley were either baked or boiled. The low rates of productivity experienced by the steam cookers can be attributed to cook's preference, little experience with this type of equipment, and lack of progressive cooking.

4. **Water Consumption.** All water for the ISO Galley was drawn from a valve at the main dining facility located nearby. The hose from the valve branched out into four separate hoses, three of which were the water intake hoses for the three main galley sections, and the last was the intake for the M-77 water heater. A meter was placed on the hose from the water valve before the hose branchout, thus measuring total water consumption. A meter was placed on each of the intake hoses to the three galley sections at the point of branching out, and one meter was attached to the hose leading from the M-77 hot water heater to

the sink within the ISO Galley. Readings from all five of these meters were recorded twice a day, once at the start of operations and again in the evening after securing the ISO Galley Complex. All warewashing was done in the Camp Upshur scullery located nearby. The rate of water consumption for food preparation, excluding beverages, in each mode per meal totaled:

Battalion Level	176 gal/1,000 men
Intermediate Size	80 gal/500 men
Small Size	39 gal/200 men

5. **Refuse Generation.** Data were collected on the weight and volume of refuse generated by the ISO Galley and personnel to determine disposal requirements for shipboard and field maneuvers. All patron waste, consisting mainly of disposable mess gear, was collected in garbage bags, one designated "dry trash" the other designated "wet garbage." All garbage bags were weighed and the weights recorded. Dumpsters were available at the test. Given the physical volume, the volume of trash generated by the patrons and ISO Galley was estimated. The average daily weight and volume of trash recorded for the A ration feeding at battalion level was 2,300 lb and 1,100 cu ft, respectively.

6. **Fuel Consumption.** Since commercial power was utilized at Camp Upshur, the fuel required to operate a generator was estimated. Considering the peak power usage recorded and the fact that an MEP-066 generator consumes 10 gallons of fuel per 100 kW, it was determined that fuel consumption was 51.6 gal/day by the most heavily loaded generator.

7. **Work Measurement.** During assigned periods of time, a data collector recorded the task performed by each food service person in the galley in 10-minute intervals. The majority of the cook's productive time, under all modes of operation, was spent in the preparation and cooking of the meal. The second most productive time-consuming task for cooks was the cleaning function. It was determined that the minimum number of cooks required to operate the galley in each mode is —

1,000-Man Mode — 5 cooks/shift

500-Man Mode — 3 cooks/shift

200-Man Mode — 2 cooks/shift

B. Twenty-Nine Palms Test Results

Following the successful concept feasibility test at Camp Upshur, changes were made, and further testing for technical feasibility and operational characteristics was carried out at the Marine Corps' facility at Twenty-Nine Palms, CA. The US Army Test and Evaluation Command (TECOM) performed the evaluations.

1. System Modifications. Following is a list of the changes made to the components in the ISO Galley as a result of recommendations following the 1980 Conceptual Test at Quantico, VA.

- a. The toaster has been changed to reduce power requirements of the system.
- b. The coffemaker has been changed to reduce power requirements of the system.
- c. A steamtable/warming cabinet has been added to both serving lines.
- d. A third convection oven was added.
- e. A new mixer has been added to furnish minimal bakery capability.
- f. The two-well sink has been changed to a one-well sink and the spray nozzle eliminated.
- g. A plexiglass shield was placed around the center galley electrical panel.
- h. The sanitizing unit has been added.

2. Test Objectives. The TECOM Test objectives are as follows.

a. **Overall:** To determine the adequacy of the system in its capability of feeding different menus to 1,000 Marines.

b. **Specific:**

(1) To evaluate the ability to transport by trailer the shelters and the equipment packed in shelters.

(2) To determine the feasibility of moving the system from one location to another for setup and reuse.

(3) To determine the capability of the sanitizing unit to sanitize mess gear with the galley operating in the 1,000-man mode.

(4) To obtain useful, measurable data pertaining to different performance characteristics of the system.

(5) To determine equipment utilization of the system.

(6) To determine the acceptance of the system by food service personnel and test participants from a human factors viewpoint.

(7) To determine the adequacy of the System Support Package (SSP) and various other maintenance aspects required of the system.

(8) To evaluate the safety characteristics of the system and to insure that recent modifications to the system incorporate safety measures.

3. Technical Feasibility/Operational Test at Twenty-Nine Palms, CA

a. **Testing.** The test was conducted at the Marine Corps Air Ground Combat Center, Twenty-Nine Palms, CA from 31 August 1981 to 26 September 1981.

(1) Testing was conducted by the Materiel Testing Directorate Representatives of TECOM utilizing equipment and facilities provided by NLABS and the USMC. Training of user personnel (1st Battalion, 1st Marines) was accomplished by NLABS on the test site (Camp Wilson). In this instance both the galley and the sanitizing unit were used.

(2) The primary purpose of this test was to gather information pertaining to the adequacy of the all-electric galley system to feed different menus to 1,000 Marines. In order to obtain this information, subtests addressed transportability, moving cycles capabilities, the feasibility of the sanitation unit, performance characteristics, maintenance characteristics, and safety features. The major types of data collected included performance characteristics and information relevant to human factors and safety considerations.

(3) The environmental impact was considered and no significant adverse impact resulted from this test project.

(4) No health hazard was identified during the course of this test.

(5) One field feeding system was utilized in this test. The battalion level mode was used and was considered an adequate sample size to insure the generation and collection of usable data and information. Data obtained have been statistically analyzed as appropriate.

(6) Constraints on the time available for the test necessitated some expedients and minor compromises of the test. Nevertheless, the results were sufficient for TECOM test monitors to conclude that the ISO Galley system can perform to the established criteria.

b. **Results.** The test results have been published.³ A summary of these results, as findings during subtests, follows.

(1) **Transportability.** The Field Feeding System was packed at NLABS, MA and transported to Twenty-Nine Palms, CA. There was no major damage that could not be readily repaired that would preclude proper functioning of the Field Feeding System as a result of transportation. However, the packaging was expedient in nature rather than in accordance with draft or approved procedures (thus probably nonrepeatable). Also, the limited test over the interstate highways was not representative of a proper transportation test.

(2) **Moving Cycles.** The system was unloaded from the transporting trailers in 46 minutes. Complete system erection was accomplished in four days. The four-day time period was not representative due to the lack of trained personnel, technical manuals, or publications. Repacking and reloading of the system was not monitored due to time constraints of the test.

(3) **Sanitation Unit.** The sanitation unit operation was in accordance with the manufacturer's specifications. Microbiological samples taken by Twenty-Nine Palms personnel on two separate occasions from utensils, glasses, trays, bowls, etc., were all negative for bacterial growth.

(4) **Performance.** Service rate data indicated that the system could feed seven to eight men per minute per serving line. Work measurement data revealed that the galley could be operated as it was at Twenty-Nine Palms, CA, utilizing 25% fewer manhours. This, in turn, means that an average of six to seven cooks and 14 to 15 mess cooks could effectively operate the Field Feeding System. Additionally, on the average, fuel consumption was 0.07 gallons, water consumption was 0.84 gallons, and refuse generation was 2.30 pounds per consumer per meal. These rates are approximate due to the limited data collected. Additionally, the water and fuel consumption and refuse generation rates for 1,000 meals per day would be somewhat higher, since on the average, fewer than 1,000 men were actually fed per meal during the Twenty-Nine Palms, CA test. Also, the air curtains above the patron exit door created excessive air movement that resulted in the loss of some smaller food items from the food trays.

(5) **System Adequacy.** Equipment utilization data revealed that the steam cookers were not used to any significant degree. For the most part, the remainder of equipment was frequently used or indispensable. There was not enough space in the galley to accommodate condiments, beverages, etc., to maintain a smooth uninterrupted flow of patrons.

(6) **Human Factor Engineering.** Generally, the cooks, mess cooks, and the patrons were favorable toward the Field Feeding System and the food prepared therein. Tray Packs were slightly preferred by the patrons with regard to taste. Also, the cooks responded favorably pertaining to Tray Pack preparation.

(7) **Maintainability.** Due to the lack of a Systems Support Package (SSP), the Maintenance Sub-test could not be properly conducted. However, strictly in terms of system reliability, the Field Feeding System did function well with a minimum of maintenance related problems.

(8) **Safety and Health.** Areas that may require attention in order to avoid possible hazardous conditions include the following:

(a) The lack of adequate nonskid surfaces on flooring and drains to eliminate water from the floors;

(b) The lack of positive action, open-door latches;

(c) The possible overloading of circuit breakers.

C. Conclusions

The following conclusions were reached.

1. The system was adequately prepared for transport to Twenty-Nine Palms but the packing could not be duplicated since no planned shipping configuration was provided.
2. The sanitation unit is capable of sanitizing the messing equipment associated with the galley when the system is operating in the 1,000-man mode.
3. The Field Feeding System can feed 1,000 men using 70 to 80 gallons of fuel and 800 to 900 gallons of water while producing 2,200 to 2,400 pounds of refuse daily. The galley can be manned by six to seven cooks and 14 to 15 mess cooks while operating in the 1,000-man mode.
4. The Marine Corps Field Feeding System was generally accepted by those Marines working in the galley and the patrons being fed from the galley.
5. The nonskid floor mats, the lack of a water drainage system, the lack of positive action open-door latches, and the evident overloading of circuit breakers require resolution to prevent the possibility of a hazardous condition.
6. There is inadequate space on the serving line to accommodate condiments, beverages, breads, salads, etc., and for smooth uninterrupted service of patrons.
7. The air curtains above the patron exit doors should be eliminated.
8. The changes made to the components in the galley as a result of recommendations following the 1980 Camp Upshur, Quantico, VA test were adequate.

D. Recommendations

It is recommended that:

1. The transportation phase of testing be rescheduled subsequent to the design of a shipping configuration;
2. The systems support package (SSP) should be established with the appropriate manuals included;
3. The nonskid floor mats should be replaced with a permanent nonskid floor;
4. A water drainage system should be added to the floors of the galley and the sanitation unit;

5. Positive action, open-door latches should be added to all doors of the system;
6. The air curtains above the patron entrance and exit doors should be eliminated;
7. The circuit breakers in the galley and the internal wiring of the system should be checked to accommodate the electrical requirement.

GENERAL CONCLUSIONS

The galley and the sanitizing unit, as depicted in this report, meet the basic requirements. They constitute a viable feeding system. The concept evaluation and limited operational testing confirmed that its capabilities are consistent with design and established manpower and utilities requirements. The system was not tested onboard ship.

The menu can be complete A ration, that is, formulated from perishable as well as shelf-stable components. The system is transportable and can be made operational within a matter of hours.

Further development and testing should be carried out before acceptance of the system for all environments can be assured. These recommended actions are, in general terms:

1. Make indicated modifications to equipment, shelters, and utility distribution system;
2. Prepare a systems support package to include appropriate manuals and a formalized packing procedure;
3. Carry out transportability testing (over unimproved roads and cross-country terrain), repeated relocation, and shipboard usage (if this last requirement remains valid).

The ISO Galley Development Program was terminated at the end of fiscal year 1981 (30 September 1981), at least temporarily, at the direction of the Marine Corps. If development is resumed, the program can proceed to full-scale engineering development. A draft Required Operational Capability (ROC) document (see Appendix C) has been prepared and, following staffing and approval, could be used as the established requirement document.

APPENDIXES

- A. Camp Upshur Menus**
- B. Twenty-Nine Palms Menus**
- C. Draft of Required Operational Capability
for an International Organization for
Standardization (ISO) All-Electric Galley**

APPENDIX A

Camp Upshur Menus

22 JULY 1980

Lunch

Hot Sliced Beef Sandwich
Mashed Potatoes
Brown Gravy
Buttered Succotash
Buttered Green Beans
Carrot Strips
Corn Relish
Pickled Cherry Peppers
Bread
Chocolate Coconut Pudding
Soft Drinks
Coffee

Supper

Creole Shrimp
Steamed Rice
Glazed Carrots
Buttered Wax Beans
Spring Salad
Assorted Dressings
Bread
Butter
Apple Crisp
Soft Drinks
Coffee

23 JULY 1980

Lunch

Baked Beef and Noodles
Buttered Peas and Carrots
Stewed Tomatoes and Croutons
Tossed Vegetable Salad
Sweet Mixed Pickles
Bread and Butter
Spice Cake
Peanut Butter Cookies
Beverages

Supper

Spaghetti with Meat Sauce
Grated Cheese
Buttered Green Beans
Buttered Mixed Vegetables
Cottage Cheese
Bread and Butter
Assorted Beverages

24 JULY 1980

Lunch

Salisbury Steak
Potatoes in Brine
Stewed Tomatoes
Bread and Butter
Tossed Green Salad
Peaches
Orange Nut Cake
Beverages

Supper

Chicken Stew
Lima Beans
Corn
Bread and Butter
Tossed Green Salad
Vanilla Pudding
Cherries in Sauce
Beverages

25 JULY 1980

Tray Packs Will be Served

Lunch

Lasagna
Potatoes in Brine
Green Beans
Bread and Butter
Tossed Green Salad
Lemon Pudding
Orange Nut Cake
Assorted Beverages

Supper

Sliced Turkey with Gravy
Potatoes in Brine
Peas
Bread and Butter
Tossed Green Salad
Cherries in Sauce
Chocolate Pudding
Assorted Beverages

26 JULY 1980

Lunch

Fried Ham Steaks
Sweet Potatoes
Buttered Asparagus
Scalloped Corn
Bread and Butter
Assorted Beverages
Confetti Salad
Chocolate Krinkle Cookies

Supper

Newport Fried Chicken
Baked Beans
Peas
Bread and Butter
Beverages
Spring Salad
Marble Cake

27 JULY 1980

Sunday Brunch

Dinner

Roast Pork
Mashed Potatoes
Gravy
Buttered Broccoli
Southern Style Greens
Bread and Butter
Cole Slaw
Devils Food Cake
Assorted Beverages

28 JULY 1980

Lunch

Chicken Cacciatore
Buttered Noodles
Paprika Buttered Cauliflower
Buttered Lima Beans
Assorted Breads and Butter
Cottage Cheese and Peach Salad
Assorted Beverages
Sugar Cookies

Dinner

Meat Loaf
Rice Pilaf
Tomato Gravy
Buttered Peas
Sautéed Corn
Bread and Butter
Assorted Relish Tray
Fruit
Assorted Beverages

29 JULY 1980

Lunch

Pork Chop Suey
Steamed Rice
Chow Mein Noodles
Buttered Green Beans
Buttered Wax Beans
Assorted Breads
Butter
Sliced Cucumber and Onion Salad
Assorted Beverages
Brownies

Supper

Baked Ham
Pineapple Sauce
Buttered Sweet Potatoes
Simmered Blackeye Peas
Buttered Mixed Vegetables
Dinner Rolls and Butter
Tossed Green Salad
Tomatoes and Cucumbers
Assorted Beverages
Refrigerator Cookies

30 JULY 1980

Tray Packs Will be Served

Lunch

Chicken a la King
Potatoes in Brine
Peas
Bread and Butter
Tossed Green Salad
Blueberry Compote
Cherry Nut Cake
Assorted Beverages

Supper

Sliced Roast Pork and Gravy
Potatoes in Brine
Corn
Bread and Butter
Tossed Green Salad
Apples in Sauce
Chocolate Pudding
Assorted Beverages

31 JULY 1980

Lunch

Crackers
Chili Con Carne
Buttered Mixed Vegetables
Southern Style Greens
Assorted Breads
Butter
Cottage Cheese
Devils Food Cake
Assorted Beverages

Supper

Baked Chicken
Mashed Potatoes
Gravy
Buttered Brussel Sprouts
Corn
Corn Bread
Butter
Lettuce Wedges
Cranberry Sauce
Sugar Cookies
Assorted Beverages

1 AUGUST 1980

Lunch

Hot Pork Sandwich
Mashed Potatoes
Brown Gravy
Corn O'Brien
Buttered Broccoli
Bread and Butter
Cucumber and Onion Salad
Spice Cake
Assorted Beverages

2 AUGUST 1980 .

Tray Packs Will be Served

Lunch

Stuffed Peppers
Potatoes in Brine
Peas
Breads and Butter
Tossed Green Salad
Butterscotch Pudding
Pears
Assorted Beverages

Supper

Beef Stroganoff
Potatoes in Brine
Corn
Bread and Butter
Tossed Green Salad
Apples in Sauce
Cherry Nut Cake
Assorted Beverages

APPENDIX B

Twenty-Nine Palms Menus

14 SEPTEMBER 1981

Breakfast

Scrambled Eggs
Hard Boiled Eggs
Sausage Patties
Ham
Hash Browned Potatoes
Pancakes
Assorted Donuts
Assorted Dry Cereals
Bread and Butter
Syrup
Assorted Beverages

Lunch

Simmered Frankfurters
Grilled Polish Sausage
Scalloped Potatoes and Onions
Simmered Sauerkraut
Relish Tray
Bread and Butter
Chocolate Pudding
Assorted Beverages

Dinner

Chicken Noodle Soup
Grilled Steak
Fried Onions
Duchess Potatoes
Buttered Green Beans
Kidney Bean Salad
Chef's Salad
Hot Biscuits
Bread and Butter
Cherry Crunch
Assorted Beverages

15 SEPTEMBER 1981

Breakfast

Scrambled Eggs
Hard Boiled Eggs
Bacon
Sausage Patties
Lyonnaise Potatoes
Apricot Quick Coffee Cake
Assorted Dry Cereals
Assorted Fresh Fruits
Bread and Butter
Assorted Beverages

Lunch

Baked Spanish Beef Patties
Lyonnaise Potatoes
Stewed Tomatoes
Hamburger Buns
Apple Crisp
Assorted Beverages

Dinner

Tomato Vegetable Soup
Pork Chop Suey
Chow Mein Noodles
Steamed Rice
Buttered Wax Beans
Waldorf Salad
Tossed Green Salad
Dinner Rolls
Bread and Butter
Yellow Cake with Chocolate Frosting
Assorted Beverages

16 SEPTEMBER 1981

Breakfast

Scrambled Eggs
Hard Boiled Eggs
Ham
Creamed Beef
Lyonnaise Potatoes
Assorted Donuts
Assorted Dry Cereals
Assorted Fresh Fruits
Bread and Butter
Assorted Beverages

Lunch

Simmered Frankfurters with Spanish Sauce
Potatoes Au Gratin
Chilled Applesauce
Frankfurter Rolls
Cherry Crisp
Assorted Beverages

Dinner

Chicken Noodle Vegetable Soup
Roast Turkey
Mashed Potatoes
Natural Gravy
Buttered Corn
Mexican Cole Slaw
Tossed Vegetable Salad
Chilled Fruit Cocktail with Sunshine Cookies
Bread and Butter
Assorted Beverages

17 SEPTEMBER 1981

Breakfast

Scrambled Eggs
Hard Boiled Eggs
Bacon
Sausage Patties
Hash Browned Potatoes
French Toast
Assorted Donuts
Assorted Dry Cereals
Assorted Fresh Fruits
Bread and Butter
Syrup
Assorted Beverages

Lunch

Baked Chicken and Noodles
Buttered Peas
Cornbread
Butter
Fruit Cocktail with Custard
Sunshine Cookies
Assorted Beverages

Dinner

Onion Soup
Grilled Hamburgers
Grilled Frankfurters
Potato Chips
Baked Beans
Buttered Spinach
Relish Tray
Chef's Salad
White Cake with Vanilla Icing
Hamburger Buns
Frankfurter Buns
Bread and Butter
Assorted Beverages

18 SEPTEMBER 1981

Breakfast

Scrambled Eggs
Hard Boiled Eggs
Bacon
Sausage Patties
Hash Browned Potatoes
Crumb Cake (Snickerdoodle) with Vanilla Glaze
Assorted Dry Cereals
Assorted Fresh Fruits
Bread and Butter
Assorted Beverages

Lunch

Tomato Vegetable Soup
Stuffed Peppers (Tray Pack)
Mashed Potatoes
Buttered Whole Grain Corn
Chilled Canned Pears with Five Star Assorted Cookies
Assorted Beverages

Dinner

Salisbury Steak (Tray Pack)
Mashed Potatoes
Buttered Peas
Tossed Vegetable Salad
Apple Crisp
Dinner Rolls
Bread and Butter
Assorted Beverages

19 SEPTEMBER 1981

Breakfast

Eggs to Order
Hard Boiled Eggs
Sausage Patties
Grilled Ham Slices
Hash Browned Potatoes
Pancakes
Assorted Donuts
Assorted Dry Cereals
Assorted Fresh Fruits
Bread and Butter
Assorted Beverages

Lunch

Chili Macaroni
Buttered Wax Beans
Cole Slaw
Pineapple Slices with Custard
Sunshine Cookies
Bread and Butter
Assorted Beverages

Dinner

Chicken Noodle Soup
Baked Canned Ham
Candied Sweet Potatoes
Buttered Spinach
Cottage Cheese Salad
Tossed Green Salad
Vanilla Pudding
Dinner Rolls
Bread and Butter
Assorted Beverages

20 SEPTEMBER 1981

Breakfast

Scrambled Eggs
Hard Boiled Eggs
Grilled Ham Slices
Creamed Beef
Hash Browned Potatoes
Assorted Donuts
Assorted Dry Cereals
Assorted Fresh Fruits
Bread and Butter
Assorted Beverages

Lunch

Green Pea Soup
Scalloped Ham and Noodles
Buttered Peas
Dill Pickles
Green Olives
Ripe Olives
Devil's Food Cake with Vanilla Icing
Bread and Butter
Assorted Beverages

Dinner

Onion Soup
Beef Stew
Steamed Rice
Buttered Whole Kernel Corn
Cole Slaw
Tossed Cucumber, Lettuce, and Tomato Salad
Brownies
Hot Biscuits
Bread and Butter
Assorted Beverages

21 SEPTEMBER 1981

Breakfast

Plain Omelet
Hard Boiled Eggs
Bacon
Sausage Patties
Hash Browned Potatoes
Apple Quick Coffee Cake
Assorted Dry Cereals
Assorted Fresh Fruits
Bread and Butter
Assorted Beverages

Lunch

Onion Soup
Beef Slices (Tray Pack)
Mashed Potatoes
Vanilla Pudding
Hot Biscuits
Bread and Butter
Assorted Beverages

Dinner

Chicken Noodle Soup
Stuffed Pepper (Tray Pack)
Salisbury Steak (Tray Pack)
Beef Slices (Tray Pack)
Mashed Potatoes
Stewed Tomatoes
Buttered Green Beans
Three Bean Salad
Chef's Salad
Peach Crisp
Dinner Rolls
Bread and Butter
Assorted Beverages

22 SEPTEMBER 1981

Breakfast

Scrambled Eggs
Hard Boiled Eggs
Bacon
Creamed Beef
Lyonnaise Potatoes
Assorted Donuts
Assorted Dry Cereals
Assorted Fresh Fruits
Bread and Butter
Assorted Beverages

Lunch

Chicken Tetrazzini
Buttered Carrots and Peas
Tossed Salad
Chilled Peach Slices
Oatmeal Cookies
Bread and Butter
Assorted Beverages

Dinner

Onion Soup
Chicken Fried Beef Patties
Hash Browned Potatoes
Cream Style Corn
Apple, Celery, and Raisin Salad
Tossed Vegetable Salad
White Cake with Buttercream Frosting
Dinner Rolls
Bread and Butter
Assorted Beverages

23 SEPTEMBER 1981

Breakfast

Eggs to Order
Hard Boiled Eggs
Bacon
Sausage Patties
Hash Browned Potatoes
French Toast
Assorted Donuts
Assorted Dry Cereals
Assorted Fresh Fruits
Syrup
Assorted Beverages

Lunch

Tomato Vegetable Soup
Ham Chunks and Potatoes
Green Beans
Pickled Beets and Onion Salad
Brownies
Bread and Butter
Assorted Beverages

Dinner

Chicken Noodle Vegetable Soup
Chili Con Carne with Beans
Steamed Rice
Buttered Carrots
Relish Tray
Tossed Salad
Chocolate Cake with Chocolate Cream Frosting
Bread and Butter
Assorted Beverages

24 SEPTEMBER 1981

Breakfast

Scrambled Eggs
Hard Boiled Eggs
Bacon
Ham
Hash Browned Potatoes
Assorted Donuts
Assorted Dry Cereals
Assorted Fresh Fruits
Bread and Butter
Assorted Beverages

Lunch

Breaded Pork Slices
Mashed Potatoes
Chilled Applesauce
Buttered Lima Beans
Chocolate Pudding
Bread and Butter
Assorted Beverages

Dinner

Tomato Vegetable Soup
Meat Loaf
Lyonnaisse Potatoes
Tomato Sauce
Buttered Green Beans
Pickled Green Bean Salad
Lettuce and Tomato Salad
Chocolate Pudding
Hot Dinner Rolls
Bread and Butter
Assorted Beverages

25 SEPTEMBER 1981

Breakfast

Scrambled Eggs
Hard Boiled Eggs
Ham
Creamed Beef
Assorted Donuts
Assorted Dry Cereals
Assorted Fresh Fruits
Baking Powder Biscuits
Bread and Butter
Assorted Beverages

Lunch

Chicken Noodle Soup
Chili Con Carne with Beans
Steamed Rice
Buttered Green Beans
Chilled Canned Pears
Hydrox Cookies
Corn Bread
Bread and Butter
Assorted Beverages

Dinner

Onion Soup
Fried Chicken
Mashed Potatoes
Butter Whole Kernel Corn
Pineapple Cole Slaw
Tossed Lettuce, Cucumber, and Tomato Salad
Apple Crunch
Dinner Rolls
Bread and Butter
Assorted Beverages

26 SEPTEMBER 1981

Breakfast

Scrambled Eggs
Hard Boiled Eggs
Bacon
Creamed Beef
Assorted Donuts
Assorted Dry Cereals
Assorted Fresh Fruit
Baking Powder Biscuits
Assorted Beverages

Lunch

Grilled Polish Sausage
Baked Macaroni and Cheese
Buttered Peas
Sweet Pickles
Green Olives
Ripe Olives
Chilled Fruit Cocktail
Five Star Assorted Cookies
Bread and Butter
Assorted Beverages

Dinner

Tomato Vegetable Soup
Spaghetti with Spaghetti Sauce
Buttered Green Beans
Cole Slaw
Italian Style Chef's Salad
Brownies
Toasted Garlic Bread
Bread and Butter
Assorted Beverages

APPENDIX C

Draft of Required Operational Capability for an International Organization for Standardization (ISO) All-Electric Galley

1. STATEMENT OF REQUIREMENT

The present Marine Corps Field Feeding System has not been keeping pace with the various innovations connected with land and/or sea operations. A requirement exists for a field feeding system which can be housed within the framework of the International Organization for Standardization (ISO), Marine Corps Expeditionary Shelter System (MCESS). This field feeding system could use both fuel and/or all-electrical power, but must be capable of feeding 250 to 1,400 personnel of a Marine Amphibious Force (MAF) size unit while aboard commercial container ships from point of embarkation to combat debarkation point and on land during combat/field operations. In the event of a Fleet Marine Force (FMF) unit being committed to an amphibious operation, adequate food preparation and serving areas would not sustain the force and optimum combat effectiveness; the combat support and combat service support organizations must furnish the essential food service facility requirements of the force. These food service facilities will be housed in multi-purpose shelter systems (MCESS) 8' x 8' x 20' which incorporate simplicity, durability, and mobility within a wide range of environments.

2. THREAT AND OPERATIONAL DEFICIENCY

a. **Threat.** Potential enemy threats confronting the United States are described in the Marine Corps Midrange Objectives Plan (MMROP) and the General Operational Requirement (GOR) for Logistics (LOG-1). The Marine Corps must be capable of feeding its Fleet Marine Forces (FMF) units from point of embarkation aboard commercial ships to the combat theater and in an adverse environment. The use of an all-electric galley housed within the Marine Corps Expeditionary Shelter System (MCESS) aboard commercial ships and in the combat zone would improve field feeding in the future.

b. Operational Deficiency

(1) The existing field feeding system does not possess the required operational equipment, nor is it housed to be set up aboard commercial ships to support effectively the FMF in the conduct of operations from point embarkation to combat debarkation point.

(2) The physical sizes and shapes in the current system would be incompatible with the standard transportation envelopes required by commercial shipping. The most prominent manifestation of this incompatibility occurs in attempting to transport current shelters (tents) in merchant containerships.

(3) Landing force and supporting units ashore during amphibious and subsequent operations require improved:

- (a) Protection from the effects of cold weather;
- (b) Environmental control in an NBC environment.

3. OPERATIONAL AND ORGANIZATION CONCEPTS

a. The design concept of the food service unit is partially defined by the kind of cooking equipment employed. Cooking equipment can be classified as either electrical or fuel burning; either kind is suitable for use in a field kitchen. However, only fuel burning equipment that uses liquid fuel has been acceptable for military applications, while fuel-fired equipment, with either the open or contained flame, is not acceptable for use aboard converted container ships.

b. Primarily for reasons of safety aboard ship, electric cooking equipment is specified for use in the proposed Marine Corps food service unit. This will not, however, eliminate the need for using liquid fuel aboard ship.

c. In converting a ship, the Marines will not, in general, be able to rely on ship systems for heat, ventilation, or electric power. The Marines will have to provide their own generators needed to power life support systems. The generators will have to be installed aboard ship, supplied with fuel, and operated safely throughout the voyage. In this case, in contrast to that of the fuel-fired cooking equipment, fuel is brought into and used within the occupied area, which can cause toxic gases and produce carbon monoxide poisoning if the venting system should malfunction. The risks of fuel leak or spill creating a fire hazard in the breathing area would be reduced by isolating the fuel and generators in an unoccupied area of the ship where emergency procedures could be initiated without first evacuating the area.

d. Relative safety is not the only advantage of electric equipment. This kind of equipment is commonly used in cafeterias and restaurants and the equipment manufacturers that supply the civilian market constitute a large and well-established procurement base. Electric equipment is very easy to use and maintain; one merely dials the desired temperature and cooks — no fuel tanks have to be filled, no fuel lines connected, no pressure gauges monitored, and no valves and nozzles have to be removed, cleaned, and reinstalled.

e. The food service unit is sized to support a battalion of 1,000 men since this is the customer group that the Marine Corps plans to support from a single unit. The food service goal is to provide these men with three A Ration meals per day and to serve these meals on reusable trays, cups, and flatware.

f. The galley section consists of five ISO shelters complexed side by side. The center shelter contains general-purpose cooking equipment, a sink, and work tables. The cooking/serving shelters on either side of the center shelter contain a serving line consisting of cooking and food warming equipment and beverage dispensers. The two shelters at either end of the complex are access shelters used for storing and dispensing serving ware and as passageways to the serving lines.

g. The galley section is designed and equipped to be symmetrical in form and function about the center shelter. The cooking/serving shelters are identically equipped and the access shelters are identical. This duplication allows the battalion-sized galley section to be separated into two smaller, independently operating galley modules. This is done by moving some equipment from the center shelter into one of the two cooking/serving shelters and then separating this cooking/serving shelter, together with its attached access shelter, from the battalion-sized complex. The two-shelter complex is the intermediate-sized galley module.

h. It is estimated that the small and intermediate modules will be capable of supporting 200 and 500 men, respectively.

i. In summary, the proposed food service unit, using modified available electric equipment, can be procured by 1982. The unit will be safe for shipboard operation and will be reliable and convenient to use in the base camp operations. The generator sets and fuel required to support the unit should not create an excessive logistics burden.

4. ESSENTIAL CHARACTERISTICS

The characteristics and operating requirements that the food service unit must satisfy are listed below.

- a. The food service unit must be housed in and operated from the 8' x 8' x 20' shelter.
- b. The food service unit must be capable of operating at sea aboard a container ship as well as ashore.
- c. The food service unit must be adequately equipped to prepare an A ration menu. Custom foods that reduce on-site food preparation are acceptable, provided, first, that an adequate production base for these custom foods can be insured before 1985 and, second, that the use of custom foods does not result in reducing the overall skill level of Marine Corps food service work.
- d. The food service unit must be equipped with items, either military or commercial, which are off the shelf, thereby decreasing the equipment development time so that a Technical Data Package can be prepared for procurement in 1982.
- e. The food service unit must be a functionally modular design to accommodate customers ranging nominally from a squadron level to a battalion/air group level or up to a Marine Amphibious Unit (MAU).
- f. The food service unit may use either electric or fuel-burning equipment. Fuel-burning equipment must use fuel expected to be available during the next decade; electric equipment must be limited to a maximum power consumption of 180 kW.
- g. The food service unit must include the means for washing and sanitizing reusable serving ware. Reusable serving ware is required because the exclusive use of disposable serving ware is unacceptable.

h. The food service unit must provide minimum protection against chemical and biological agents.

i. The food service equipment will require minimum maintenance and be capable of being maintained by food service personnel.

j. The food service equipment must be adaptable to standard Marine Corps Mobile Electric Power Systems.

5. OTHER WARFARE AREAS CONCERNED

Not applicable.

6. RELATED EFFORTS

The US Army Natick Research and Development Laboratories (NLABS) has been tasked by DoD to perform all tactical research and development for DoD components. The Food Engineering Laboratory is conducting operation and design to support Marine Corps food service equipment.

7. TECHNICAL FEASIBILITY AND COST FORECAST

The technology for building an all-electric galley has been developed and tested. All required technologies are within the state of the art. Cost for advanced development has not been determined. Based upon information provided by NLABS in preliminary reports, the cost of developing the all-electric galley forecasted in FY78 dollars is as follows:

a. Galley equipment costs	\$ 47,065
b. Sanitation equipment costs	13,690
c. ISO rigid shelters (7)	91,000
d. Quadcons (2)	4,000
e. Water modules (2)	9,000
f. ISO reactor (2)	30,000
g. Generator (3)	45,500
h. M-77 water (2)	<u>7,600</u>
	\$246,655